TITLE: Method and arrangement for implementing fast signalling in an asymmetric communication connection

TECHNOLOGICAL FIELD

The invention concerns generally the technology of transmitting limited amounts of control information over a communication connection. Especially the invention concerns the transmission of such control information in the uplink direction, also known as the reverse direction, of a wireless communication connection between a base station and a mobile station.

BACKGROUND OF THE INVENTION

The information to be transmitted between a base station and a mobile station in a cellular radio network can be basically categorised into user data and signalling, of which the latter refers to the transmission of such information which the stations use mostly to monitor and control the smooth operation of the communications connection. In order to facilitate the administration of communications resources there are usually defined separate channels for user data and signalling. For example in the known GSM (Global System for Mobile telecommunications) system three basic types of signalling channels have been defined: the SACCH (Slow Associated Control CHannel), the FACCH (Fast Associated Control CHannel) and the SDCCH (Standalone Dedicated Control CHannel). The first two of these being "associated" control channels means that a certain dedicated user data channel must exist before the definition of these control channels makes sense. The SACCH occupies every 26^{th} of the regularly occurring burst periods allocated to a full-rate circuit-switched communications channel. Other implemented or suggested SACCH timetables exist for other than full-rate channels. The FACCH does not have a regularly occurring allocated radio resource: whenever an FACCH message needs to be sent, a burst or a part thereof is "stolen" from its original use of conveying user data and used to convey signalling information instead. The SDCCH, which is sometimes referred to as the TCH/8 (Traffic CHannel at eighth rate), corresponds to the allocation of one burst period from every eighth TDMA (Time Division Multiple Access) frame for the duration of an active communications connection on SDCCH.

The expansion of the use of cellular radio networks from circuit-switched voice telephony towards wireless internet applications means that the old definitions of channels and connections need to be revised. At the priority date of this patent application it is assumed that in many cases the needs for communications resources will be highly asymmetric, which means that the amount and rate of information to be transmitted in one direction over the radio interface is much larger than that transmitted in the other direction. For example network browsing involves only a limited amount of lookup and download command data to be sent in the reverse direction while the amount of data downloaded in the forward direction from network pages to a terminal device may be fairly large. EDGE (Enhanced Datarates for GSM Evolution) and the services relying on it, EGPRS and EHSCSD (Enhanced General Packet Radio Service, Enhanced High Speed Circuit Switched Data), introduce several known schemes for implementing high-capacity channels especially in the downlink direction but also for uplink.

Even a communication connection which is nominally unidirectional may benefit from the possibility of transmitting a limited amount of information also in the other direction. As an example, let us consider a nominally unidirectional wireless communication connection where the transmitting station employs transmitter diversity. In other words, there are at least two transmitting antennas located far enough from each other for the envelope correlation of signal fading between them to be relatively low. Data is transmitted blockwise through each antenna. The data blocks transmitted through different antennas are otherwise the same but equipped with different training sequences. This difference enables the receiving station to estimate the phase difference between the signals which it receives from said different transmitting antennas. Fast feedback should be employed in order to make the transmitting station to adapt the relative phasing of the transmitting antennas so that the signals add constructively in the receiving station. In another antenna diversity arrangement both antennas transmit with even the same training sequence, and the phase difference between antennas is first changed in a random fashion. The receiving station provides feedback that describes the effect of the random changes on constructive adding at the receiving end. By comparing the feedback to the history of changes the transmitting station learns quickly, what is the currently optimal phase difference between transmitting antennas. It is easy to understand that the volume of information concerning the amount of constructive adding or the phase difference estimated at the receiving station and provided as fast feedback in the reverse direction is minimal compared to that of the data transmitted in the nominal transmission direction.

Transmission power control of the closed-loop type requires always some feedback information to be conveyed to the station the transmission power of which is to be controlled. Within the framework of ECSD (Enhanced Circuit Switched Data) of EDGE (Enhanced Data rates for GSM Evolution) the concept of fast power control has been standardised for novel circuit-switched services. Fast power control aims at keeping the signal level or the signal quality at the receiving station at an adequate level. However, few fast power control methods are known that would also be suitable for use in packet-switched connections with asymmetric capacity requirements.

The concept of adaptive beam forming, especially closed-loop adaptive beam forming, resembles transmitter diversity in the sense that the correctly selected and adapted physical processing of the signal at the transmitting station requires a minimal but finite amount of feedback information to be transmitted in the reverse direction. On the basis of the received feedback the transmitting device that uses adaptive beam forming selects dynamically the antenna parameter values so that the resulting antenna beam is optimal to a certain distant receiver. The basic difference between beam forming and transmitter diversity is that in the former the parallelly transmitting antennas are located much closer to each other than in the latter. Consequently signal fading is largely correlated between antennas and changes in phase difference are slower. Adaptive beam forming techniques can cope with sparser feedback signalling than transmitter diversity.

Other transmission technologies, which are known as such but would benefit from fast asymmetric reverse signalling are for example various header compression techniques and statistical multiplexing.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide a method and an arrangement for implementing fast signalling in a communication connection with potentially asymmetric capacity requirements.

The objects of the invention are accomplished by defining a generally non-dedicated piece of transmission capacity at the radio interface as a fast signalling channel which is available for a relatively large number of devices that need to transmit fast signalling. Certain aspects of the invention are also accomplished by making such devices first check, whether the fast signalling needs could be fulfilled